TRANSACTIONS OF THE INSTITUTION OF CIVIL ENGINEERS.

AN ACCOUNT OF THE NEW OR GROSVENOR BRIDGE OVER THE RIVER DEE AT CHESTER.

Continued from p. 311.

The Act of Parliament under which this bridge has been built was obtained in the session of 1825 ; the works were contracted for by Mr. James Trubshaw, of Haywood in Staffordshire, early in 1827, and immediately commenced, the son of the contractor being resident throughout ; the first stone was laid by the present Marquess of Westminster (then Earl Crosvenor) on the 1st of October in the same year ; and the bridge was formally opened on the 17th of October, 1832, by the Princess Victoria, on the occasion of Her Royal Highness's visit to Eaton Hall, and named, at the request of the Commissioners, Grosvenor Bridge, but it was not thrown open to the public generally until New-Year-Day, 1834.

The total cost of the work was £49.900, in which is included a sum of £7500 for the heavy embankments required in the approaches. The money was partly raised by bonds, and partly advanced by the Commissioners for the Loan of Exchequer Bills, and is secured on tolls charged both on the new and the old bridge, the revenue yielded by which is about £3000 a-year.

The following table*, containing the leading dimensions of the largest stone arches that have been built (from 150 feet span upwards), will enable a comparison to be made between the bridge it has been the purpose of this paper to describe, and others approaching but not equalling it in magnitude of arch.

Name.	River.	Form.	Span. Feet.	Rise. Feet.	Keystone. Ft. In.	Date.	Engineer.
Claix (Grenoble)	Drac	Circular	150	54	3 1	1611	
Gloucester	Severn	Elliptical	150	35	4 6	1827	Telford.
London	Thames	Elliptical	152	37½	4 9	1831	Rennie.
Tournon	Doux	Circular	157	65	......	1545	
Verona	Adige	Elliptica	160	53	......	1354	
Lavaur	Agout	Elliptical	160	65	10 9	1775	Saget.
Gignac	Erault	Elliptical	160	44	6 5	1793	Garipuy.
Vieille-Brioude	Allier	Circular	178	69	5 3	1454	Grenier and Estone.
Chester	Dee	Circular	200	42	4 0	1833	Hartley.

* The dimensions of the continental bridges have been gathered from M. Perronet's *Description des Projets et de la Construction des Ponts*, M. Gauthey's *Traite de la Construction des Ponts*, and Von Wiebeking's *Theoretisch-Practische Wasserbaukunst ;* and in the cases of the discrepancies that sometimes occur, (particularly as to the span of the ancient bridge of Vieille Brioude, which is stated to be 183 feet by Perronet, in his bold project for the bridge of Melun, and also as to the rises of some of the other arches,) Gauthey's Work has been preferred, as it seems entitled to be from the character of its talented editor, the late M. Navier, in whose death the Institution has too soon to lament the loss of a valued honorary member.
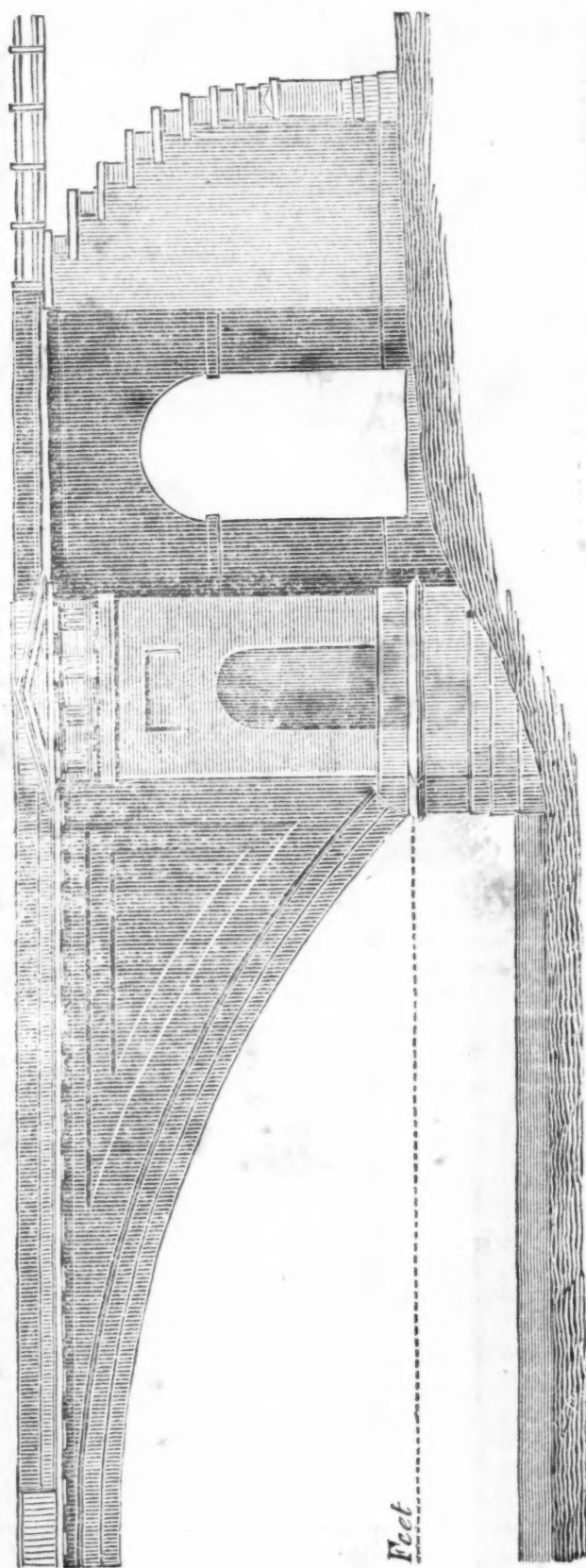
Plate 6.

CHESTER
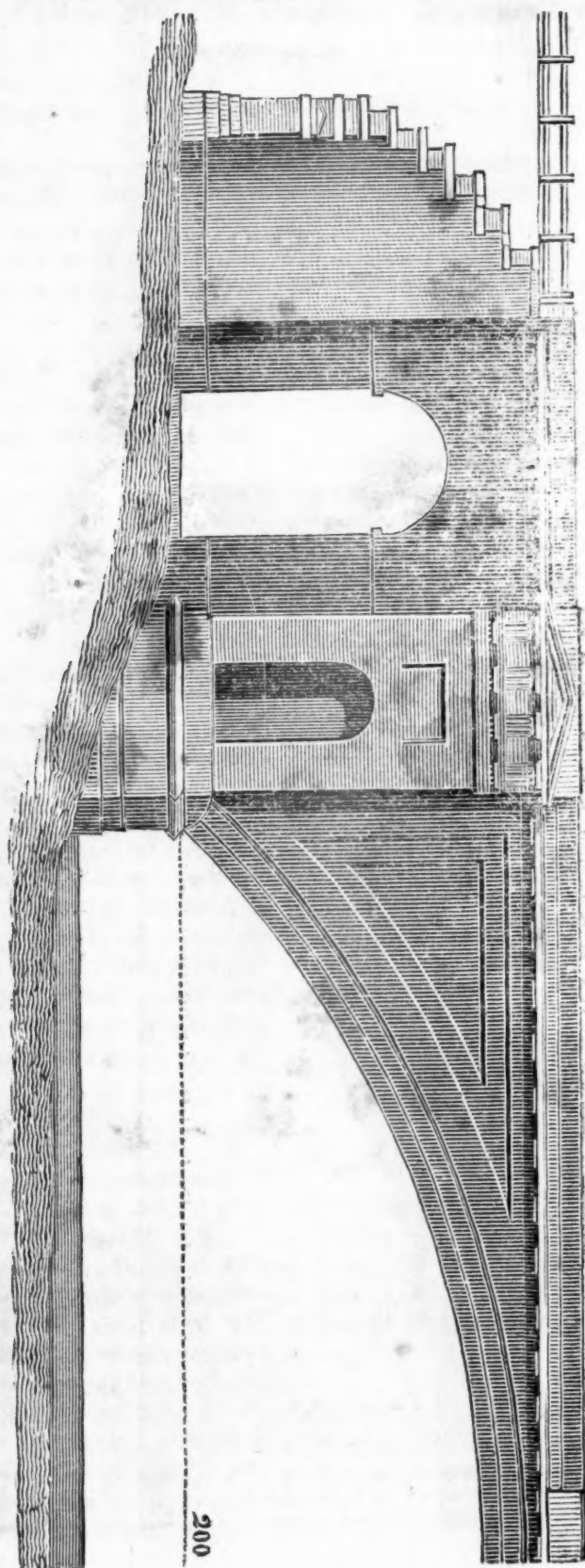
200

BRIDGE.

Feet

ON THE STRAIN TO WHICH LOCK GATES ARE SUBJECTED. BY PETER W. BARLOW, CIVIL ENGINEER.

TABLE II.

| Length of Gate.	6 FEET DEEP. Strain produced by the pressure upon 3 feet surface.	6 FEET DEEP. Dimensions of Square Timber necessary to bear three times that strain.	8 FEET DEEP. Strain produced by the pressure upon 3 feet surface.	8 FEET DEEP. Dimensions of Square Timber necessary to bear three times that strain.	10 FT. DEEP. Strain produced by the pressure upon 3 feet surface.	10 FT. DEEP. Dimensions of Square Timber necessary to bear three times that strain.	12 FT. DEEP. Strain produced by the pressure upon 3 feet surface.	12 FT. DEEP. Dimensions of Square Timber necessary to bear three times that strain.	14 FT. DEEP. Strain produced by the pressure upon 3 feet surface.	14 FT. DEEP. Dimensions of Square Timber necessary to bear three times that strain.	16 FT. DEEP. Strain produced by the pressure upon 3 feet surface.	16 FT. DEEP. Dimensions of Square Timber necessary to bear three times that strain.	18 FT. DEEP. Strain produced by the pressure upon 3 feet surface.	18 FT. DEEP. Dimensions of Square Timber necessary to bear three times that strain.	20 FT. DEEP. Strain produced by the pressure upon 3 feet surface.	20 FT. DEEP. Dimensions of Square Timber necessary to bear three times that strain.
FEET.	TONS.	IN.	TONS.	IN.	TONS.	IN.	TONS.	IN.	TONS.	IN.	TONS.	IN.	TONS.	IN.	TONS.	IN.
5	1.601	4.86	2.134	5.35	2.668	5.77	3.202	6.13	3.735	6.45	4.269	6.74	4.803	7.01	5.336	7.26
6	1.921	5.49	2.561	6.05	3.201	6.52	3.842	6.92	4.482	7.29	5.123	7.62	5.763	7.93	6.403	8.21
7	2.241	6.09	2.987	6.70	3.735	7.22	4.483	7.67	5.229	8.07	5.976	8.45	6.724	8.78	7.470	9.10
8	2.561	6.66	3.414	7.32	4.268	7.89	5.123	8.39	5.976	8.83	6.831	9.23	7.685	9.60	8.538	9.94
9	2.882	7.20	3.841	7.92	4.802	8.54	5.763	9.07	6.723	9.55	7.684	9.95	8.645	10.38	9.600	10.75
10	3.202	7.72	4.268	8.50	5.336	9.16	6.404	9.73	7.470	10.24	8.538	10.71	9.606	11.14	10.672	11.54
11	3.522	8.23	4.695	9.06	5.869	9.76	7.044	10.37	8.217	10.92	9.392	11.41	10.566	11.87	11.739	12.30
12	3.842	8.72	5.122	9.60	6.402	10.34	7.684	10.98	8.964	11.57	10.246	12.10	11.526	12.58	12.806	13.03
13	4.162	9.20	5.548	10.12	6.937	10.90	8.325	11.59	9.711	12.20	11.099	12.76	12.488	13.27	13.874	13.74
14	4.482	9.67	5.974	10.64	7.470	11.46	8.966	12.18	10.458	12.82	11.952	13.40	13.448	13.94	14.940	14.44
15	4.803	10.12	6.402	11.14	8.064	12.00	9.606	12.75	11.205	13.42	12.807	14.03	14.409	14.55	16.008	15.12
16	5.122	10.56	6.828	11.63	8.536	12.53	10.246	13.31	11.952	14.01	13.662	14.65	15.370	15.24	17.076	15.78
17	5.443	11.00	7.255	12.11	9.071	13.05	10.887	13.86	12.699	14.60	14.514	15.26	16.330	15.86	18.142	16.43
18	5.763	11.43	7.683	12.58	9.603	13.55	11.526	14.40	13.446	15.16	15.369	15.85	17.289	16.48	19.209	17.07
19	6.083	11.85	8.109	13.04	10.138	14.04	12.167	14.93	14.195	15.72	16.222	16.43	18.251	17.09	20.277	17.70
20	6.404	12.26	8.536	13.49	10.672	14.54	12.808	15.45	14.940	16.26	17.076	17.00	19.212	17.68	21.344	18.31

In making use of the above Table, for obtaining the necessary dimensions of the lower timbers, it has to be considered that a great support is afforded by the sill of the Gate, which will of course permit with safety the use of less timber than the Table will give. The influence of this support cannot, however, extend beyond the second timber from the bottom, as the deflection of the planking will allow the whole of the pressure to be effective:

EN -

Curved Lock Gates.

In locks of large dimensions in this country, a curved figure is given to the gates, so that when united they resemble a Gothic arch; this figure, by giving greater strength permits a reduction to be made in the dimensions of the timber, and the gates are thereby rendered lighter, and more readily movable. The degree of curvature which will give the greatest strength, and the necessary dimensions of the timber in different sized locks, are of course points of considerable importance, not only on the score of economy, but from the greater degree of lightness that may be thus obtained; the opening and shutting can be performed with greater ease, and consequently a greater number of ships can be permitted to pass in a given time.

In order to estimate the degree of curvature which will give the greatest strength, it is first necessary to consider the nature and amount of the strains to which the Gothic shape gives rise, we may then perceive what variations, with respect to the degree of curvature and amount of salience, will tend to increase the strength, or vice versa.
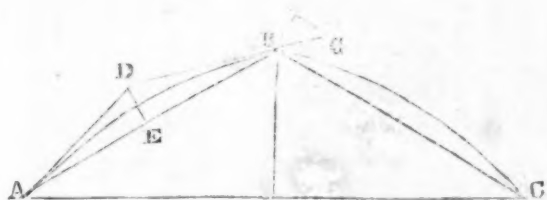
Let AB, BC represent two gates meeting in the point B, and let the angle of salience, BAC, be equal to φ, also the angle DBE of a tangent to the curve of the gate, with the cord BA = θ, and the pressure of water upon each gate = w. The gate AB, being loaded equally all over, will exert a pressure in the direction of the tangent, to the extremity of the gate, which will be represented by the line D B, (the perpendicular D E being equal to $\frac{1}{2}w$,) or equal $\frac{1}{2}w$ cosec θ.

This force is partly resisted by the compressive force of the opposite gate, which now, instead of adding to the transverse strain, as in the straight gates, is the means of diminishing it in proportion as it counteracts or destroys the tangential force D B. In order therefore to estimate the amount of strain, it becomes necessary to get an expression for this force, which may be done as follows. Let B F represent the force

acting at right angles to the extremity of the gate B C, tending to turn it upon the point C, which is of course equal to half the pressure of water. Resolving this into the direction of the tangent of the curve AB, by drawing FG parallel to BC, and producing D B, we obtain the line BG, which represents the compressive force of the gate BC in the direction of the tangent D B, and which is equal $\frac{1}{2}w$ cosec $(2\varphi - \theta)$.

As the diminution of strain owing to this force is, in proportion it destroys the tangential force DB, the amount of the transverse strain at any angle, φ and θ may be found by the following proportion:

$$\tfrac{1}{2}w \operatorname{cosec} \theta : \tfrac{1}{2}w \left\{ \operatorname{cosec} \varphi - \operatorname{cosec} (2\theta -) \right\}$$
$$:: \tfrac{1}{2}w : x$$

$$\text{Or, } x = \frac{\tfrac{1}{2}w \left\{ \operatorname{cosec} \theta - \operatorname{cosec} (2\varphi - \theta) \right\}}{\operatorname{cosec} \theta}$$

$$= \tfrac{1}{2}w \left\{ 1 - \frac{\operatorname{cosec} (2\varphi - \theta)}{\operatorname{cosec} \theta} \right\}$$

$$= \tfrac{1}{2}w \left\{ 1 - \frac{\sin \theta}{\sin (2\varphi - \theta)} \right\}$$

which is the true expression of the transverse strain or weight applied transversely in the middle of the length, which would have equal effect in breaking the timber.

It will at once be seen that when the gates united from a complete arch, that is, when the angles φ and θ become equal, the expression vanishes, the tangential force being then resisted by an equal compressive force in the opposite gate.

In this position, therefore, if the curve was mathematically true, the strain perfectly equal and regular, and the material also of an uniform density, the loading the arch would have no other effect than that of direct compression in the direction of the fibres, a description of strain which timber possesses great power to resist, as appears from the experiments of Girard. In practice this cannot, however, take place; the curve can neither be perfectly true nor the density of the material uniform, either of which defects would lead to a transverse strain, which, if sufficient weight was put on, would ultimately destroy the gate. In the former case, the flatter parts of the curve would naturally have a transverse strain upon the bottom fibres, from the abutments or terminations of it not being resisted with an equal degree of compressive force; the fibres would in consequence in some measure yield, and the relative position of the gates at the point of meeting would be

changed, so as not to touch equally throughout; an increased compression would be brought upon particular fibres, which must of course yield, and the evil would continue to increase until fracture ultimately took place. In a similar manner, an irregular density of the material, by causing a yielding in some parts more than others, would bring on a change of shape which would ultimately produce the same results.

It therefore appears that in either case the cause which ultimately leads to fracture is the transverse strain produced from the irregularity of the curve, brought on by circumstances which cannot be controlled. Hence the nearer the curve can be preserved in the true figure of an arc of a circle, the greater the strength of the gates.

It has however to be considered that the arch is not composed of one complete timber, but that the fibres are disunited at the point of meeting, and consequently if that part from any cause should become flattened there are no fibres to resist the transverse strain thus produced; and as the flattening of this part of the arch is an effect which might probably arise from any yielding of the abutments, or wear of the heel posts in the hollow quoin, this would evidently be the weakest part of the curve. It therefore becomes necessary to deviate in a small degree from the true curve of the arch, by giving the gates greater length, and causing them to meet at a point a short distance from the curve, or in fact rendering them slightly Gothic; but as the security to the point is obtained at the expense of a constant transverse strain upon each of the gates, the deviation from the true arched figure should be as little as possible, consistently with the object in view, and by no means so great as is commonly employed in lock gates: I should think a deviation of one foot or eighteen inches quite sufficient for the purpose of locks of from forty to fifty feet wide.

General Remarks.

It was my intention to have concluded the preceding part of the article with a Table of the requisite dimensions of timber for gates of different sizes, both of the curves commonly employed, and of those which I should recommend; I find, however, that these calculations would require a greater length of time than I can at present devote to the subject, and I therefore conclude with a few general remarks on the results arrived at.

In the first place, with respect to the proper angle of straight gates, this being a subject naturally calculated to excite the propensities of the mathematician to set his maxima and minima to work, a great number of solutions to the problem have been given; but I must remark, with every respect for that useful class of men, that they are frequently too anxious to commence investigations without sufficient data, and consequently arrive at results totally incorrect, which has certainly been the case in those investigations I have had an opportunity of examining on the subject.

It seems to me perfectly impossible to arrive at correct results, without first ascertaining the amount of transverse strain produced by the end pressure, which does not seem to have been done before; but having obtained this from Girard's experiments to be one-tenth of the effect of an equal weight in the middle of the length, I have little doubt that the angle 19° 25' would be found, by experiments, to be very nearly that in which the greatest strength would be obtained with a given quantity of timber.

The angle commonly adopted in this country, is considerably more than 19° 25', amounting generally to between 30 and 40 degrees, which is said to be preferred from the direction of the thrust being met by a large quantity of brickwork. I cannot, however, conceive this to be a matter of much importance, particularly as there are locks on the continent, of large dimensions, where the angle is considerably less, which have stood perfectly well. The angle of the celebrated sea-lock of Muyden is only 16° 30', and the ancient lock of Sparendam, which was built in 1568, and has stood many storms without injury, has a sally of not more than one-sixteenth:—the angle ought certainly to be in some measure guided by the circumstances in which the gate is placed; at the same time, I consider the angle commonly made use of in England, to be decidedly larger than necessary, and a useless weight of material employed, which increases one of the evils of canal navigation,—the time consumed in passing the locks.

The employment of curved timber is undoubtedly advantageous, but its application is evidently made upon no fixed principles, as may be seen from the differences of the curves which have been adopted; some being so great as to very nearly approach the figure I have pointed out as the best, while others are so exceedingly flat that they possess little advantage over the straight gate.

To illustrate these differences in wooden gates, I have represented, in the accompying drawing, the curves employed in the gates of the St Katharine's, London, and West India Docks. The dimensions are as follows:—

ST. KATHARINE'S DOCKS.

Width of the lock	45 feet.
Projection	11
Radius of the gate	117

Consequently the angle $\varphi = 29°\ 16'$, and $\theta = 6°\ 8'$.

LONDON DOCKS.

Width of the lock	40 feet.

Projection	9
Radius of the gate	50

Angle $\varphi = 23°\ 35'$, and $\theta = 13°\ 54'$.

WEST INDIA DOCKS.

Width of lock	45 feet.
Projection	10
Radius of the gate	120

Angle $\varphi = 26°\ 24'$, and $\theta\ 5°\ 53'$.

With the aid of the preceding formulæ I have calculated the amount of transverse strain in each case, (half the pressure of water upon one gate being unity,) and the same, if they were of straight timber, having an equal salient angle. These formulæ are arranged in the following Table.

In order to make the comparison of the straight and curved gate more direct, there is also added a column of the amount of transverse strain on the latter, that on the straight gate being unity.

The fourth column illustrates the reduction of the dimensions of square timbe which may be permitted owing to the dir minished strain.

TABLE III.

GATE.	Transverse strain, $\frac{1}{2}w$ being unity.	Transverse strain of straight timber having the same salient angle, $\frac{1}{2}w$ being unity.	Transverse strain, that on the straight gate being unity.	Dimensions of timber having equal strength, that on the straight gate being unity.
At St. Katharine's Docks,	·86	1.178	·73	·900
London Docks,	·56	1.229	·45	·766
West India Docks	·86	1.201	·72	·806

It thus appears that considerable advantage is gained in each case from the curvature, but that in the London Docks, from the radius being less, and the two gates in consequence approaching nearer the curve of a complete arch, the advantage is much greater, and the transverse strain in consequence reduced to less than half that of straight gates having the same salient angle.

The difficulty of obtaining timber of sufficient curvature has been urged as a reason for the flatness of the curves employed in wooden gates; this is certainly a consideration which must be attended to, but as similar curves are employed when the material made use of is cast iron, I cannot conceive this to be a point which has materially influenced the choice of the figure.

In the accompanying drawing (Plate VI.) are given the curves of the gates of the Caledonian Canal, the Dundee Docks and Sheerness Basin, which are of cast iron: they will be found to differ very materially from each other, being in one instance nearly as flat as in the West India and St Katharine's Docks.

The following are the dimensions :—

CALEDONIAN CANAL.

Width of the lock	40 feet·
Amount of projection	10 "
Radius of curvature	75

Angle of sally $\varphi = 30°$, and $\theta = 8° 3'$

DUNDEE DRY DOCKS.

Width of entrance	40 feet.
Amount of projection	7 feet 6 inches.
Radius of curvature	67 feet.

Angle of sally $\varphi = 22° 2'$, and $\theta = 9° 12'$,

SHEERNESS BASIN.

Width of entrance	58 feet.
Amount of projection	12 feet 6 inches.

Radius of curvature   55 feet.
   Angle $\varphi = 24° 5'$, and $\theta = 16° 55$.

To make a comparison of these curves, I have calculated a Table, as in the case of the wooden gates, containing the amount of the transverse strain which straight gates would have under similar circumstances.

The same formula is employed for this purpose as for the wooden gates, which may not be strictly true with cast iron; but I should not conceive the difference to be sufficient to affect materially the comparison.

GATE.	Transverse strain, half the pressure of water being unity.	Transverse strain of a straight gate, with the same salient angle.	Transverse strain, that of the straight gate being unity.	Dimension of iron of similar section with the straight gate, that of the latter being unity.
At Caledonian Canal	·82	1.173	·700	·887
Dundee Docks	·72	1.247	·58	·834
Sheerness Basin	·44	1.215	·35	·704

It thus appears that in the gates of the Caledonian Canal the transverse strain is nearly as great as in the West India and St. Katharine's Docks. In those of the Dundee Docks and Sheerness Basin, a considerable improvement is made, particularly in the latter, where the strain amounts to little more than one-third of that which straight gates would have in the same situation; but I conceive that by slightly diminishing the salient angle, and increasing the curvature of the gates, the advantage might be carried still further,—the same strength produced by less weight of material, and a lightness given which would greatly facilitate the passing and repassing of vessels.

MECHANICS' INSTITUTE.

PROCEEDINGS OF THE MECHANICS INSTI-
TUTE OF THE CITY OF NEW-YORK.

The weekly Tuesday Evening Scientific Meetings heretofore held in the Lecture Room of the Institute, will be re-opened on Tuesday Evening the 9th inst., at 8 o'clock, by a lecture from Mr. Hodge, on machine and other drawing. N. B. Mr. H., proposes opening a drawing-school in the Rooms of the Institute, should sufficient encouragement be given.

Chemical examination of the stomachs of two individuals supposed to have been poisoned by Arsenic—being the substance of a paper read before the Mechanic's Institute of the city of New-York, August 1836, by James J. Mapes, Esq.

No. 1. In the first case the coats of the stomach only were subjected to examination. They were cut into small fragments and subjected to the action of distilled water, at a temperature of 212°, for 3 hours.

To a small portion of the solution was added ammoniacal nitrate of silver; a bulky yellow precipitate fell down, which afterwards changed to a reddish brown, and was inferred to be a phosphate combined with animal matter; for had it been arsenite of silver it would have precipitated more rapidly, and presented a more decided color.

To a second portion of the solution, ammoniacal sulphate of copper was added to precipitate the arsenic, if any, in the form of an insoluble arsenite of copper, (scheele's green) a slightly green precipitate was formed, but of a doubtful character. This test, as well as the last, is entirely circumstantial; for common salt, onions, garlic and some other substances would, if recently partaken of by the deceased, have produced the same effect.

A third portion of the solution was sub-jected to the action of sulphuretted hydrogen, but no precipitate was formed.

A portion of the stomach apparently much inflamed, having been previously removed, was carefully dried to expel all the water, and to decompose the animal matter, was heated with black flax in a glass tube for the reduction of the arsenic, if any, in the metallic state : but no metallic ring, garlic, odor or white vapor appeared. On throwing the contents on burning coals,—an effect that is uniformly produced when metallic arsenic is converted to an oxide, or the oxide converted to the metallic state by means of heat; but even this odor is not conclusive evidence, as zinc is capable of producing the same odor. The metallic ring of arsenic, however, is considered as the best evidence we can have, amounting as it does to demonstration.

No. 2. Stomach with some of the contents was boiled as No. 1, in distilled water for three hours. The water in this case was slightly acidulated with nitric acid; the solution was filtered and evaporated to dryness, to drive off the nitric acid, re-dissolved and filtered, to get rid of the animal matter.

To a portion of the solution ammoniacal nitrate of silver was added; and to another portion was added the ammoniacal sulphate of copper, with results similar to those in No. 1. A third portion of the liquid was subjected to the action of sulphuretted hydrogen, which threw down a yellow precipitate. This precipitate being dried and heated with black flax in a glass tube gave none of the usual indications of arsenic.

As the two stomachs were brought to me preserved in alchohol, a liquid which is capable of taking up considerable quantity of arsenious acid, I filtered and evaporated, the solution; occasionally adding distilled water until the alchohol was entirely evapo-

rated. With the ammoniacal nitrate of silver, the precipitate was quite characteristic ; with the ammoniacal sulphate of copper it was too white and gelatinous ; with the sulphuretted hydrogen the precipitate was too dark for the sulphuret of arsenic, this product on being dried and heated with black flax, gave no indication of metallic arsenic.

From the above experiments, I feel assured that no arsenic was contained in either of the stomachs above mentioned, their contents, or in the alcohol which preserved them, as both the circumstantial and positive tests would have detected, the one hundredth part of a grain had it been present.

The fact that no arsenic was found in the stomach, does not, however, prove that arsenic was not the cause of death ; and especially, as the deceased vomited much and for a considerable time. The patient might have died either from the immediate or from the after effects of the poison, though none of this mineral was found. Had the patient died from the after effects, the arsenic would have been indicated by the inflamed state of the inner coat of the stomach, which would have been covered with red spots ; and such was, indeed, the case. It is highly probable, therefore, that the arsenic had been entirely removed from the stomach, by vomiting, before death.

There is a case of the same kind recorded in the Philadelphia Journal of Pharmacy, for July, 1834. The case was examined by Doctors James B. Rogers, Geo. W. Andrews and Wm. R. Fisher.

A lady was poisoned by arsenious acid, in soup, and died the same day, having vomited much. On examining the stomach and contents, not the slightest trace of arsenic was perceptible ; but from a portion of soup that had been saved, it was obtained in abundance, by every test that was used. Doctors Prout and Christison, and Prof. Braude, have also cited cases similar to the above.

APPLICATION OF STEAM TO AGRICULTURE.

Hitherto Agriculture has received little advantage from labor-saving machines compared with that which has been rendered to manufacturers and the mechanic arts ; and although many of the implements of agriculture have been greatly improved, especially those great implements, the plough and the thrashing machine, the toil of human hands is still in full requisition ; and as great an amount of animal labor as ever, is demanded on our farms. By what means this is to be materially lessened does not at present appear ; but when these inventions and discoveries shall have been made, of which at least we will indulge a hope as not being distant, we shall perhaps then be as much surprised at the simplicity of the invention as were the companions of Columbus at his method of causing an egg to stand upon the small end. Professor Renwick lately deceased,[*] to the great regret of the friends of science, had made considerable progress in the application of steam to the purposes of ploughing, though we are ignorant of the particulars of his invention ; in England they seem to have advanced in this matter, with considerable success, as appears from some accounts given in one of the late numbers of the British Farmers Magazine, from which we copy the following remarks.

" That the steam-engine would, at no very distant day, supply the place of animal labor in agriculture ; and become as mighty an instrument in augmenting the productiveness of the soil, as it has proved in creating and economising manufactures, in navigating the ocean, and in travelling on land, was many years since predicted by Franklin (?) a prediction reiterated by Davy ; and latterly acknowledged and enforced, as a great desideratum in science by many distinguished agriculturists. The

[*] The Report of Professor Renwick's death was, happily unfounded.   Eds. New-York Farmer.

successful application of Mr. Heathcoat's invention to the culture of bogs, the most repellent and obstinate of waste lands, leaves no room to doubt its applicability to soils already in cultivation. Coals are now procurable throughout Great Britain at prices, which have caused the steam-engines to be extensively introduced as a substitute for animal labor in many of the processes connected with agriculture.— Threshing, cleaning, grinding corn, chaff-cutting, and turnip-slicing, &c., are now performed by small engines, fixed on farm premises ; even the churn has its steam-engine, managed by the dairy maid ; and so great is the advantage arising to the dairy farmer from the regularity of motion ; and economy produced by it, that hundreds of small engines, for this simple purpose alone, are used in the north of England and Scotland. But these are humble savings, compared with the benefits to be derived from the vast steam power, which may be applied to the soil itself. Those agriculturists who are acquainted with the effects produced by the valuable sub-soil plough, recently invented by Mr. Smith of Deanston, will readily appreciate the importance of an invention, which will enable them to employ that kind of plough at a much diminished cost per acre. Mr. Smith's plough, with steam-power, will effect a re-revolution in agriculture. Implements of husbandry have hitherto been restricted, in form, weight, and dimensions, to the management of a team of horses. A new class of instruments will take their place. The stiffest soils may be broken up, and pulverised to any desired depth ; strong clays, the natural wheat lands, may be profitably cultivated, rendered more fertile, and fitted to bear a better, and more systematic rotation of crops.

Such are a few of the benefits, which land owners and agriculturists will derive from this substitution for animal power in husbandry. It is also no slight advantage, in a national point of view, that this important change will be effected, unaccompanied by any of those temporary evils, which too frequently attend the application of mechanical discoveries to existing arts. This invention will not displace a single individual from his accustomed healthy occupations; it will, on the contrary, occasion new and increased employment for agricultural laborers : it will restore to the support of man a considerable share of that large amount of produce, now sacrificed to the maintenance of agricultural horses ; it will furnish employment to the rapidly increasing rural population of the empire, by rescuing millions of acres of bog and waste land from obnoxious sterility ; it will find on their native soil multitudes of those Irish laborers, who annually emigrate to Great Britain in search of work and food ; or who are forced with numbers of our own countrymen to prefer the dangers and hardships of emigration to wild and distant countries.

In the Mechanics' Magazine for July, there is a notice of a steam-plough, projected by Mr. Dickson, who has no doubt of its efficacy to plough all sorts of land, and adds that portable steam-ploughs will ere long be going about, and undertaking to plough for whomsoever may desire their assistance ; and with very little more preparation than is now required to place a portable thrashing machine." An Edinburgh news-paper, states, that " Mr. Craig of that city, has taken out a patent for an American steam-plough, which costs much less than Mr. Heathcoat's, but probably is not sufficiently powerful for bogs. From our knowledge of the business of a farm the only objection we have to a steam-engine in such an establishment is, that it cannot do every thing. For all purposes, where horses cannot or should not walk, as on many descriptions of bog, a steam-plough may answer well; and there is no doubt that old arable land may be properly plough-

ed with steam-power ; but would it also take the corn to market and do all other kind of road work. Would it carry out dung ; and carry corn to the barn, or hay to the rick yard? If not then some draft horses must be kept; and if there be not a full complement, such work would go on very slowly and unsatisfactory."

" Since writing the above we have seen an account of a steam-plough made by Mr. Upton—London. He affirms that it can be made generally useful, and that an enormous saving in the expenses of a farm where it may be introduced, wi'l soon be manifest. This steam-plough of Upton's is worked by Upton's patent lever steam-engine and his air-furnace boiler. If a single shared plough, the space occupied by the entire machine will be four feet by ten feet ; if for trench ploughing, the dimensions will be the same ; if for ploughing two, three or more parallel furrows at once then the breadth and length will be about five feet by twelve. The work done by the trenching ploughing, will be equal to any spade husbandry ; and that by the parallel shares will be found very superior to any horse ploughing ; inasmuch as the ground will not be trod or rammed down by horses feet ; and as the steerer and ploughman will ride on the machine, the land will be left as light and open as possible, and resemble that of garden culture. To the steam-plough a harrow, drill, and seed box can be attached, when requisite, and the entire operation performed at one going, when it is for the last ploughing, without trampling the soil. The spots left in the angles of the field by Upton's steam-plough will be smaller than by any horse plough, as the steam-plough will turn if a single share, in thrice the breadth and length of a common wheel-barrow ; and if a three shared plough, it will turn in the space of a small one horse cart. The simplicity of construction and small number of parts

composing this steam-engine and boiler, and the great safety and security of the latter, will prevent the necessity of frequent and expensive repairs, as the only parts of the apparatus liable to wear and tear are the plough shares, soles, coulters, and harrow tines, which will only require the same repairs as if drawn by horses. The engine and boiler are calculated to go 50,000 miles or more, before any repairs could be wanted, unless from accident or unfair usage ; and whenever from long use, very much worn, if the boilers were to burst, it could only extinguish its own fire without injury to any person close to it. The plough will require one steady man to direct and steer it ; and a tractable boy to attend the fire and turn the steam off and on occasionally, the engine being of the most simple and efficient construction. The water tank will require replenishing now and then ; and perhaps fuel will be required two or three times in the course of the day ; and the boiler is admirably constructed for burning either wood, peat or coke, or coal may be used. The single plough is calculated to do two acres per day. The double plough will do four acres ; and the three shared plough will do six acres. The counter or trench plough would do about ten acres per day ; but as it would be equal in power to the double shared plough, it would require the same quantity of fuel and expense.— The land cultivated by this plough would doubtless be found, from its efficiency, to produce crops nearly if not quite equal to spade husbandry, with which mode of husbandry I am thoroughly acquainted from practice ; and in such case it would pay for the steam the first season."

Such are the accounts, which are given of these great inventions, upon authority, which must certainly be deemed respectable. We may be excused for remaining in some degree incredulous, as to the extraordinary advantages, which are here predict-

ed to be brought about by them. At the same time it would imply a very gross self-esteem to say that no further improvements in this matter can be made ; and an unwarrantable distrust of the testimony of other men, though they may be interested parties, to pronounce all there statements fictitious and visionary. We have no doubt that very great improvements in these matters are in progress ; and after witnessing the wonderful and almost miraculous results of mechanical ingenuity and skill as applied to other of the arts within a few years past, we indulge the sanguine hope that great things are yet to be realized in this most important of all arts, agriculture, which even our dreams have not anticipated.

Our common ploughs have within a few years passed through most valuable improvements. The use of the cast iron plough has greatly reduced the expenses of their construction and repairs, and has already saved millions of dollars to the farmers in the country. The improved construction of the ploughs has likewise greatly reduced the power required for the draft, and the work is much better executed than formerly. In this matter however great improvements are still desirable.— The manner of our executing our work in general is wretchedly slovenly : and bears no comparison to the ploughing of the Scotch and English laborers. This in part is to be ascribed to the division of labor among them, where a ploughman is only a ploughman, and trained exclusively to this business from his childhood With us it is not so ; but we may hope that these fine examples of work, which these emigrants often set before us, together with the great improvement in the instrument itself, will stimulate to a more vigorous and successful emulation.

H. C.

CULTIVATION OF THE PRAIRIES.
Second Estimate for three hundred and twenty Acres.

Three miles, or 960 rods, at 20 rails per rod, gives 19,200 rails.	
Add for enclosures, cribs, &c. 1,300 ; total of rails, 21,500, at $35, gives	$752 50
For well, laying up fence and one house,	175 00
For breaking three hundred acres, (allowing remaining twenty for enclosures, &c., at $2 25, gives	676 00
Add for contingencies,	25 00
	$1,628 50

Making near $5 per acre.

The above calculations may vary a few cents per acre, owing to slight fluctuations in price of laborers. One hundred acres will cost about $6 50 per acre, same buildings, &c. ; and eighty acres will cost about $8 30 per acre, same buildings, &c.

I have found no difficulty in renting one hundred acres of land, fenced, at $2 50 per acre. The tenant made a handsome sum by the lease. It is common to hire land that is fenced or has been broken up, and give one third of the crop delivered in the crib or barn.

You will perceive the profit on one hundred acres, 40 bushels of corn is a small crop ; 75 to 80 bushels a good one ; one hundred acres, at 40 bushels, will yield 4,000, one third of which is 1,333 bushels, which, at 25 cents, is $3 33 per acre.— When the canal to Lake Erie is made, the price will be double ; 30 bushels of wheat, is a fair crop ; one third, 10 bushels, is equal, at present prices, to $12 50—deduct expenses, it will be $6 per acre ; one half of the grass crop would be a fair proportion for the landlord, equal to one ton, which will be worth on the land $8, and deduct $1 for pressing, will leave $7 profit per acre, which will be doubled by carrying to New-Orleans.

Many farmers raise a sod crop, by dropping corn in the furrows when ploughing is done ; sometimes this succeeds well, but there is too much uncertainty about it to make definite calculations. As a general

remark, I would observe, that the first two crops will pay for the land, at government prices, fence the same and plough it, and on 320 acres, build a house worth $200. The land will sell readily at $10 per acre, if improved.   Yours, respectfully,
                                    E. A. ELLSWORTH.
To HON. H. L. ELLSWORTH,
                        Washington City, D. C.
                        Danville, Nov. 12, 1836.

DEAR SIR—

Your favor of August 30th, was duly received; and in answer to your inquiries, I can say, that:

1. "Does your prairie land bear good wheat?"   None can hardly be better.

2. "How is the best way to improve prairie land?"   By ploughing it in the months of May, June, and July, with a plough peculiar to this country, which cuts a furrow two feet wide, and commonly three inches deep, upon which sod, corn, oats, wheat, and most kinds of grain, grow well the first year, and with no farther labor in ploughing.

3. "How much wheat, corn, or oats, do you realize per acre?"   The first year or so, of wheat, commonly thirty bushels; oats, forty bushels; corn, 30, &c., &c.— The second year more of corn and oats, and not much of wheat.

4. "Do sod crops do well?"   They generally are fine, in a good season.

5. "How much grass on an acre?"— I can't say, but over two tons, when well set.

6. "Can blue grass be harrowed in on the turf?"   It can, and does well.

7. "Can herds grass also: is this the best way?"   It can also, and this is the best way.

8. "Is your country good for hogs?"* Not so good; it is too cold—yet there is good pork made here.

9. "Can you keep cattle on blue grass?"

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* Reference is here made to the *prairies,* which have no shelter for hogs. In the woods adjoining, hogs live all winter on mast, and thrive well. The Wabash valley is famous for its hogs. I have kept a large herd of swine this past summer on the prairie. Timber will soon be planted, or sheds built, and then pork can be most easily raised on these lands.—H. L. E.

They are kept by some all winter on blue grass, if snow is not too deep.

10. "Is your prairie good for beets?" It is the best for all garden stuff, that I have ever seen, and there can be none better.

11. "Is there coal near you?"   The coal beds here are inexhaustible; they are found almost on every considerable creek, and perhaps as much in Vermillion county, as any in Illinois.

12. "What is the price of cattle now?" About $4 per cwt., and higher now than formerly, owing to the great emigration and demand for them; and from the rapid settlements, they will not be lower, most likely, for years.

13. "How do ditch and turf fences do?" As yet, I have seen none upon the right plan; but a ditch and sod sown with blue grass, I have no doubt will answer every purpose, instead of fence.

14. "What is the comparative expense of rail fence and ditching?"   That depends upon the distance you haul the timber.— But ditching may, by proper arrangements, be done cheap.

You ask me farther, whether I can furnish blue grass seed? I can, to the amount of sowing two hundred acres per year, price $1 per acre.   This seed can also be got at Louisville and Cincinnati.

You have the goodness to say, that I may add any information in my possession. I do it cheerfully, believing that we have one of the finest countries in the United States.   My experience here in farming has been not inconsiderable.

The prairie grass is an excellent substitute for tame grass, if it is well cured, and cut early.   This grass, early in the spring, is equal to any pasture in the old States, and some have said better; but when it becomes hard, in August and September, it is of little or no account.   A man and two horses can plant and tend forty acres of corn on the prairie, when the sod is well rotted; and, as an average crop, there will be fifty bushels per acre, and sometimes more.   Oats grow finely, and yield from fifty to seventy bushels, on ground well tended.   I think, also, there is no country superior to ours for hemp and tobacco; at least, none of the southern states in which I have been.

Sheep do as well here as in Kentucky,

even on the prairie grass. I need hardly add, that this country is peculiarly adapted to the raising of mules, horses, and cattle, and they can be raised cheaper here than any state in which I have been, fifty per cent. at least I will say.

Fruit trees that I have tried, have grown remarkably thrifty, and, perhaps, faster than in most countries—which is the case of all trees. I have grown, from the seed, black and honey locust, sugar and walnut trees, ash and hickory—that of nine years' growth, is nine inches in diameter. My pear trees, about nine inches long when planted, produced fruit the sixth year.— My apple trees, from the seed, produced the fifth year; and some of the trees this year, (the ninth year, yielded me twenty bushels to the tree. I will not forget to mention, that flax also is luxuriant in its growth here.

You have said that you have the sugar beet seed, and proffer to send me a few, which will be most acceptable. I would like some of the hedge thorn for experiment also.

I live adjoining your land, and have eight persons in my family, and during this, and for years past, have had none sick in my family. This perhaps, comprises all you may wish to know about our delighted country.

I have the honor of being yours, &c.,
JAMES NEWELL.
To Hon. H. L. ELLSWORTH,
Washington City, D. C.

From the R. R. Journal.
NEW-YORK, April 22d, 1837.

GENTLEMEN—Being a reader of your very useful Journal, I have observed that much has been said respecting the performance of the Locomotives of Mr. Norris, and their superiority in ascending inclined planes. I do not doubt the statements of Mr. Norris as regards the power of his Engines, and presume that his experiments have been correctly made; but they were all made when the road was dry and in the best possible condition: if the rails had been wet the result would have been much less, owing to the decrease of the adhesion in wet weather.

The communications which have been published in the Journal, between Mr. Norris and Mr. A. G. Steere, of N. Y. and Erie Railroad, have probably been caused by the miscalculation of the gravity of loads upon inclined planes, by Mr. Steere, he using the rule given by Pambour, the fallacy of which is very apparent, at least it appears not to give the result we wish to find, as it would give all the gravity on an angle of 45°, which is impossible; a weight suspended with all its gravity will hold or retain at a state of rest one of twice as heavy on an angle of 45°.

I admit that the rule given is perfectly applicable, as it respects the velocities of falling bodies upon inclinations; but what is necessary in the case under consideration, is, to find what weight suspended with all its gravity, or what amount of power applied to the crank of the Locomotive, will hold or retain at a state of rest, any given load, on any given inclination; then if a sufficient quantity of weight or power be applied to overcome the friction, the load will commence moving up the the plane.

I will submit the following table to those interested in the subject, and one of great importance in the construction of railways.

	Level.	5¼th per mile. $\frac{1}{1000}$	7 ft. per mile. $\frac{1}{751}$	12 " $\frac{1}{440}$	16 " $\frac{1}{330}$	21 " $\frac{1}{250}$	50 " $\frac{1}{106}$	66 " $\frac{1}{80}$	106 " $\frac{1}{50}$	360 " $\frac{1}{15}$	1056 " $\frac{1}{5}$	5280 " $\frac{1}{1}$
Angles of inclination	0	m. 3.5	m. 4.6	m. s. 7.8	m. 10.3	m. 14	m. s. 33.3	m. 43.8	dg.m. 1.12	dg.m. 3.40	dg.m 11.20	dg. 45
Gravity of a ton in lbs.	ten. 0	lbs. 1.6	lbs. 2	lbs. 3.3	" 4.4	" 5.7	13.8	" 17.8	" 30	" 92	" 286	" 1120

I have not been very precise in my calculations and experiments in forming the above table, but it will be found to vary much from the result of the rule used by Mr. Steere, in his calculations; by the above table, the gravity of a ton (2240) on an angle of 4°, would be 100 lbs.; but by rules given, it would be 156.8, as an

angle of 4° is 7 feet rise in the 100 or 369 per mile. I will leave this subject to be settled by those more interested and better qualified for the task than myself.

Very respectfully,

Your ob't serv't,

E. F. ALDRICH.

WILMOT'S EARLY RHUBARB.—To those who cultivate the Rhubarb, we would earn. estly recommend the Wilmot's Early, before any other variety. We have seen it this season at Mr. Pond's garden in Cambridgeport, two inches high. The growth is very rapid. This is a plant which every body may cultivate. The fruit is considered a delicacy, and medical men ascribe to it a salutary effect, particularly upon children. Four roots are enough to supply a family.

MANUAL LABOR SCHOOLS AND COLLEGES. We are so satisfied of the importance of these American innovations upon the old worn-out system of education in Europe, and of their congeniality with the spirit of our republican institutions, that we take great pleasure in urging upon the community the necessity of engrafting them deeply into the structure of all our schools and colleges—public or private. As an example of their great utility we refer to an oration recently delivered by a pupil of the Manual Labor High School of Elyria, Ohio, as inserted in the Advertiser of that place. The vigor of thought shown in this document, is itself a proof of the invigorating influence of wholesome manual labor in useful arts conjointly with the exercise of the mind, on more speculative and abstruse studies.— Many of the students, we learn, of this school entirely support themselves by their manual labor. The orator, referring to the- olden systems, says truly :

"They are destructive to human life ; though they cultivate the tree of science, they sow the seeds of death. Now what is to be done ? Shall the cause of education be abandoned? Shall the world fall back into barbarism ? Or shall science continue to be watered with human blood, and college bowers become the graves of the students ?"

Again :

"Does manual labor have a good effect

upon the body ? Evidently it does ; it enlivens the circulation of the blood, strengthens the digestive powers, and keeps in healthful action the whole system ; and the most serious effects often result from confinement ; the limbs become weak, the operations of the system sluggish, the whole body debilitated, and some fatal disease soon follows. Now, if it has these effects upon the body, it must have a very strong effect upon the mind, by means of the sympathy which exists between the two,—so that, when the body is diseased, the mind is incapable of discharging its functions. Can a fine lady pursue the business of a milliner in a house daubed with filth and covered with cobwebs ? just as possible for the mind to pursue its employment in a body made sluggish by inaction and tainted with disease. Another great benefit arising from the manual labor system, is, the pecuniary aid it renders to the student ; and, indeed, without this aid, the benefits of education would be denied to a great part of community."

[Our common schools afford abundant education gratuitously, but they do not give food and raiment.]

"Some oppose this system no doubt, for the very reason which makes the republican and the philanthropist love it ; because it unlocks the temple of science, throws open the iron gates, and bids the indigent youth enter and eat of the banquet hitherto provided only for the rich."—[Sunday Morning News.]

NAVIGATION.—Our bay and the channel out of the harbor, have been clear from ice for the last day or two, though the lake by us is yet much clogged ; but being completely broken up, we hope to be rid of it in a few days.—[Dunkirk Beacon.]